WHITE PAPER

USDA Forest Service Pacific Northwest Region Umatilla National Forest

**WHITE PAPER F14-SO-WP-SILV-34**

# Silvicultural Activities: Description and Terminology[1]

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Initial Version: **JUNE 1992**
Most Recent Revision: **FEBRUARY 2013**



[1] White papers are internal reports; they receive only limited review. Viewpoints expressed in this paper are those of the author – they may not represent positions of the USDA Forest Service.

# INTRODUCTION

Silviculture is defined as the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis (Helms 1998, USDA Forest Service 2004). This white paper defines many silvicultural terms, and it provides database and geographical information system (GIS) codes for the most commonly prescribed cutting methods.

In the early 1990s, the advent of ecosystem management created some confusion about silvicultural terminology and how it should be applied. Whether it was appropriate or not, some land managers were abandoning historical definitions and creating new silvicultural terms, even when the new terms were being used to describe old (traditional) ways of managing the forest.

In some situations, new terms were being coined to avoid old ones tainted with a timber production bias or because the old terms were considered inflammatory (clearcutting). In other instances, the new terms represented a conscious and deliberate effort to match the name of a term with predicted conditions or outcomes resulting from application of ecosystem management or adaptive management concepts.

As a result of uncertainty about the proper application of silvicultural terminology in an era of ecosystem management, one of the objectives of this white paper is to describe a consistent set of silviculture terms and their associated definitions.

# SILVICULTURAL SYSTEMS

A silvicultural system is defined as "a planned series of treatments for tending, harvesting, and reestablishing a stand" (Helms 1998). Most of the management treatments being used in western forests can be assigned to one of three silvicultural systems (USDA Forest Service 2004; the coppice system is excluded due to its limited relevance in western North America):

1. **Even-aged silvicultural system**: a planned sequence of treatments designed to create or maintain a stand with predominantly one age class. The range of tree ages for an even-aged forest is generally assumed to be 20 percent or less of the rotation age (fig. 1).
2. **Two-aged silvicultural system**: a planned sequence of treatments designed to create or maintain a stand with two age classes (fig. 1).
3. **Uneven-aged silvicultural system**: a planned sequence of treatments designed to create or maintain a stand with three or more age classes (fig. 1).

These silvicultural systems include cutting methods designed to obtain regeneration (regeneration cutting methods), and a variety of cultural practices for modifying tree density and otherwise contributing to the development of an immature stand (intermediate cutting methods).

## Age-Based Silvicultural Systems

Strictly defined, an even-aged stand has trees of the same age such as a plantation established in a single year. Uneven-aged stands theoretically contain trees of every age, ranging from seedlings that became established this year to mature veterans several centuries old. These arbitrary definitions mark the two end points of what is actually a continuum, and in nature, stands resembling either of the theoretical end points are seldom found.

In practical terms, even-aged stands are those where the trees comprising the main canopy layer have an age difference of no more than 20 percent of the rotation length (the age at which a mature stand is to be regenerated). Uneven-aged stands contain trees in at least three distinct age classes and there are generally wide gaps in their age class distribution, such as a stand with an intermingling of old trees, mid-age trees, and young regeneration (fig. 1).

## Even-Aged Management

Even-aged management involves application of regeneration and intermediate cutting methods to create and maintain an even-aged stand. The even-aged regeneration cutting methods are clearcutting, seed-tree cutting, and shelterwood cutting. The even-aged silvicultural system also includes thinning, improvement cutting, release, and other intermediate cutting methods. Even-aged regeneration cutting methods are described below.

### Clearcutting

*The Scientific Basis for Silvicultural and Management Decisions in the National Forest System* (Burns 1989) defines clearcutting as “the harvesting in one operation of all trees with the expectation that a new, even-aged stand will be established.” Regeneration then occurs following natural seeding from adjacent stands, from seed contained in the timber harvest debris (slash), or from artificial regeneration treatments (planting or direct seeding).

There are many variants of clearcutting; two common variants are strip clearcutting, and continuous or patch clearcutting. Patch clearcutting is divided further into large-patch clearcuts, which are larger than two acres and would logically be managed as separate stands or polygons following treatment (USDA Forest Service 2002), and small-patch clearcuts, which are smaller than two acres and would not be managed as individual stands after harvest.

Figure 2 shows an example of large-patch clearcutting as it was traditionally practiced; clearcutting with reserves as clearcutting is currently implemented by leaving islands of residual live trees and standing dead wood as snags (Franklin et al. 2007); small-patch clearcutting; and strip clearcutting.

### Seed-Tree Cutting

Burns (1989) defines seed-tree cutting as a “clearcut except for a few seed-producing trees selected to naturally regenerate the harvested area.” This regeneration cutting method differs from shelterwood cutting in that the seed trees are usually too far apart to provide much site amelioration (shade or shelter). Seed-tree cutting involves two steps: a seed cut and a removal cut.

To be considered a seed-tree seed cutting, the prescribed treatment must have an expectation (objective) for establishment of even-aged regeneration and, on average, at least six desirable trees are retained on each treated acre. The residual trees must be capable of producing seed, regardless of whether or not they were retained for this purpose (fig. 3).

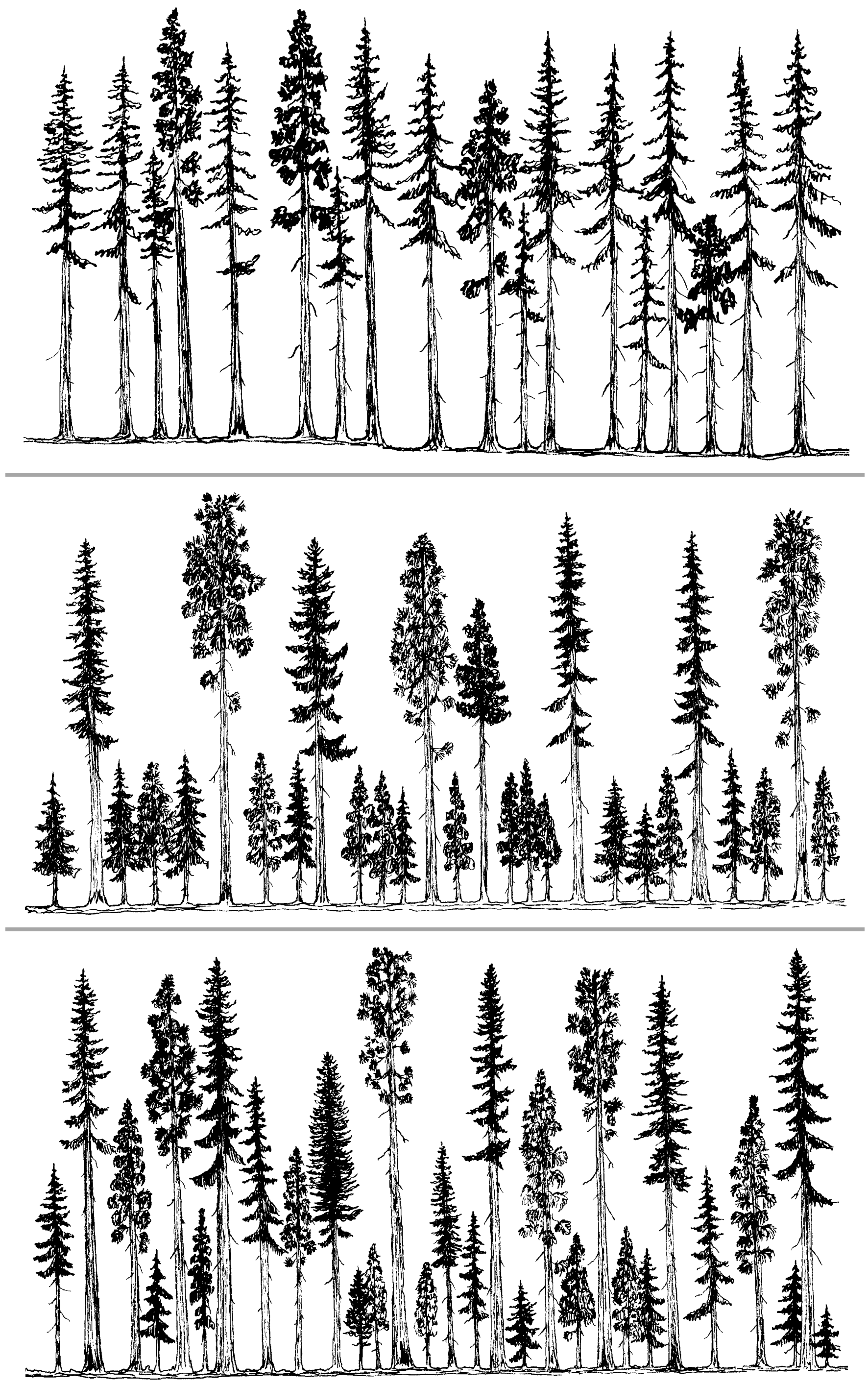

**Figure 1 –** Three common stand structures (from Powell 1994). Even-aged stands (top) are single-cohort because trees in subordinate canopy positions (these are referred to as overtopped, subcanopy, or suppressed trees) result from a forest development process called differentiation; smaller trees are not younger trees in even-aged forests (O'Hara and Oliver 1999). Two-aged stands (middle) and uneven-aged stands (lower) are multi-cohort because subcanopy trees became established at different times (Oliver and Larson 1996).

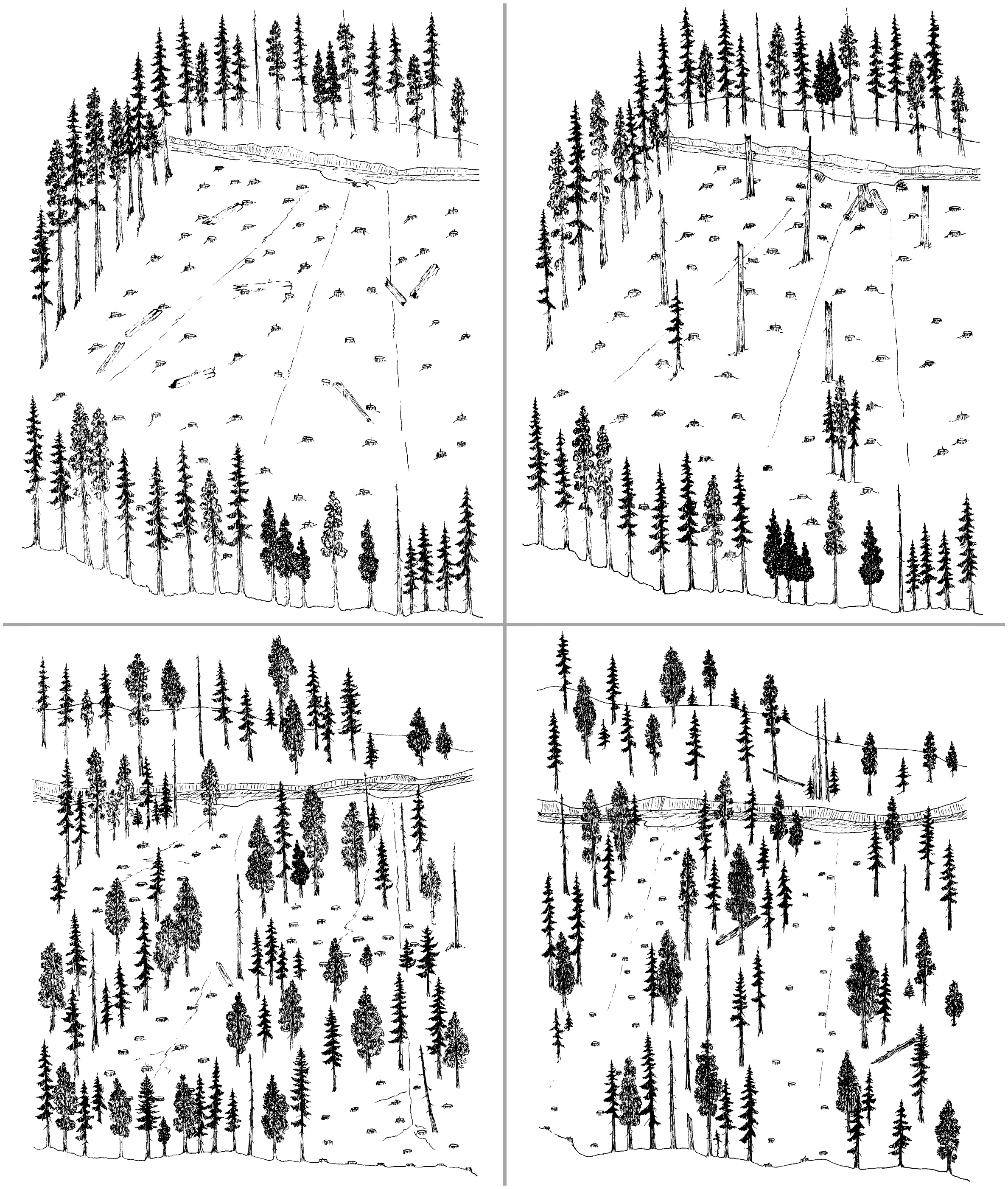

**Figure 2 –** Clearcutting. Traditional large-patch clearcutting (upper left) removed all of the live trees and most of the dead wood from an entire stand area. Clearcutting with reserves (upper right) retains a few live trees and some dead wood. Small-patch clearcutting (lower left) removes trees from areas too small to be managed as separate stands. Strip clearcutting (lower right) creates a post-treatment condition resembling ski runs, and it is often used to redistribute the snowpack and augment water yields. Note: it is often assumed that any cutting creating openings smaller than 2 acres is group selection. However, either small-patch clearcutting or group selection can be used to create openings of 2 acres or less – what is important is the answer to this question: Will the stand be managed (and regulated) using the even-aged (clearcutting) or uneven-aged (group selection) silvicultural system (see items #4 and #5 on pages 14-15)?

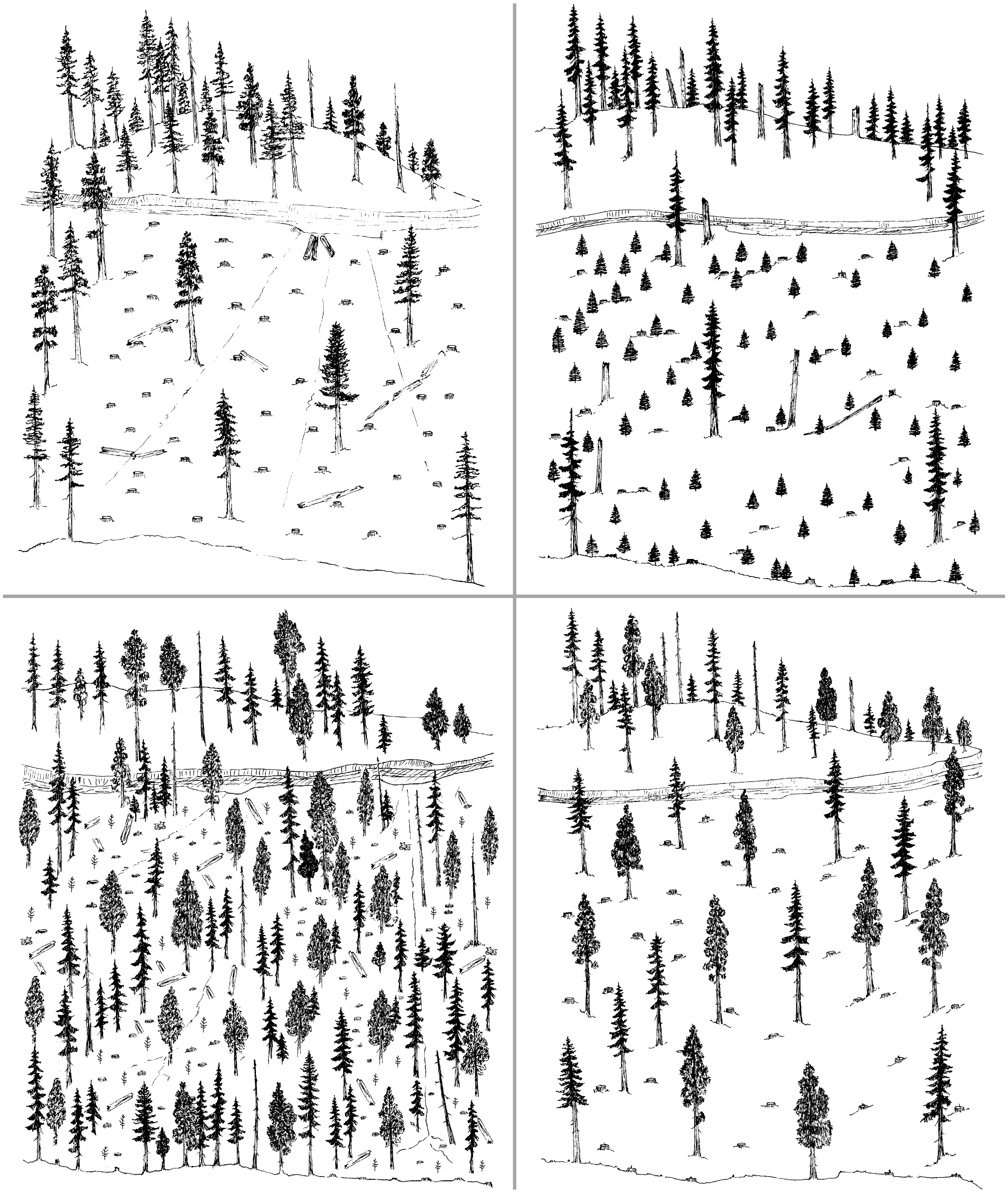

**Figure 3 –** Seed-tree and shelterwood cutting. Seed-tree seed cutting (upper left) leaves at least 6 residual trees per acre, and they must be distributed in such a way as to ensure adequate natural regeneration. Seed-tree cutting with reserves (upper right) reserves all or some of the seed trees for non-regeneration objectives such as green-tree snag replacements. Shelterwood preparatory cutting (lower left) is the first cut in a 3-step shelterwood sequence; it is generally used with spruce-fir stands in the cold-forest zone or in other situations with high windthrow risk. Shelterwood seed cutting (lower right) is the first cut in a 2-step shelterwood sequence, or the second cut in a 3-step shelterwood sequence; it is often used with either dry-forest or moist-forest stands in the montane zone. A shelterwood seed cut leaves at least 12 residual trees per acre distributed in such a way as to ensure adequate natural regeneration.

Note: This white paper contains many references to ‘desirable’ trees. Desirable trees are those whose characteristics contribute to meeting desired future conditions and other Forest Plan (FP) components; undesirable trees lack such characteristics. When FP components change from one management area to another, trees considered to be desirable could also change.

For particularly dense stands, retaining the largest trees in the seed cut may allow them to develop vigorous crowns and tapering (stable) stems. Retaining trees with enough disease or damage to limit their seed production would not qualify as a seed-tree seed cut, although reserving such trees for wildlife purposes and other management objectives might be desirable.

### Shelterwood Cutting

The shelterwood regeneration method involves a series of entries designed to improve the vigor and seed production potential of residual trees, and to provide suitable conditions for seedling establishment. To be considered the shelterwood method, the prescription must include an explicit regeneration objective (even for a preparatory cut). Shelterwood cutting involves either two or three steps (fig. 3). Generally, the shelterwood cutting method is used to create an even-aged or two-aged stand over a period of 20 years or so.

A three-step shelterwood includes a preparatory cut, a seed cut, and a removal cut. Three-step shelterwoods are traditionally used in special situations, such as areas with high susceptibility to windthrow caused by shallow soil depth, a high water table, tree species with shallow roots, or spindly trees with height-to-diameter ratios of 80 or more.

The three-step shelterwood variant, for example, is often ideal for regenerating shallow-rooted species such as Engelmann spruce on areas with physical site factors contributing to high windthrow potential. In the northern Blue Mountains, sites with high windthrow potential frequently have a volcanic ash-cap or loess-dominated layer overlying residual soils of Columbia River basalt (fig. 4).

Typical application of the shelterwood regeneration method involves a two-step shelterwood, which has a seed cut and a removal cut. Most of the time, a uniform shelterwood is used, which means that the seed cut and removal cut are applied to the entire stand area. An irregular shelterwood refers to unusual variants such as strip or group shelterwoods, where seed and shelter are provided from the side rather than from directly overhead.

Shelterwood cutting differs from the seed-tree method in that sufficient residual trees are retained to influence environmental conditions for an entire stand, rather than just a small area around each reserve tree. Shelterwood seed cuts retain twelve or more well-distributed trees on each acre.

The appropriate number of residual trees for shelterwood cutting will vary from one area to another because it depends on tree species, diameter, height, crown width, slope position, aspect, and other biotic and abiotic factors. As was the case for seed-tree cutting, the residual seed trees must be capable of producing acceptable quality and quantity of seed.

**Figure 4 –** Windthrow in spruce-fir forest in the northern Blue Mountains. Engelmann spruce is a shallow-rooted species, which increases its susceptibility to windthrow for almost any site condition. But abiotic factors can also contribute to increased wind damage because this site has an ash or loess layer above residual soils derived from Columbia River basalt or lacustrine (lakebed) sediments. These soils (typically Andept soil types) have high water-holding capacity, an important aspect of Engelmann spruce habitat. Flat areas and north-facing slopes have well-developed vegetation inhibiting soil erosion, allowing the ash to be retained on site. However, a relatively thick mantle of loamy, fine-textured ash or loess may lack structural integrity, providing poor anchorage for tree roots. Silvicultural options could be limited for wind-susceptible sites: avoid tree harvest altogether; salvage windfall as storms continue to unravel the forest; or gradually open the canopy by using intermediate cutting methods, or the preparatory cut of a 3-step shelterwood method (Alexander 1987, Roe et al. 1970).

## Overstory Removal Cutting

Overstory removal cutting is used in multi-layered stands with a fully stocked understory of healthy and desirable advance regeneration (fig. 5). The objective of this cutting method is to mimic the removal cut of a 2-step shelterwood sequence, and for this reason, it is often referred to as the simulated shelterwood cutting method (Alexander 1987, Nyland 1996).[2]

In the Blue Mountains, overstory removal cutting was often viewed as an ideal solution to the silvicultural problem presented by tens of thousands of acres of multi-cohort stands resulting from almost 100 hundred years of fire suppression. Overstory removal cutting seemed to offer the best response to this management issue for at least four reasons:

- It avoided the cost of tree planting, an expensive practice.
- It avoided the undesirable appearance associated with clearcutting.
- It maintained the pleasing aesthetics of a green, forested setting.
- It captured the accumulated growth of understory trees existing for 60 years or more.

[2] The term 'simulated' shelterwood recognizes that regeneration was established by Nature instead of by man (i.e., if a shelterwood seed 'cut' occurred in the past, Nature did it rather than man). Note that human alteration of a keystone ecosystem process (suppressing surface fire over the last century) also helped create the multi-cohort stands that are often managed using the simulated shelterwood method.

The potential advantages of overstory removals were not realized for the Blue Mountains because this method is incompatible with many forest health issues: the late-seral, shade-tolerant advance regeneration is highly susceptible to drought, defoliating insects (western spruce budworm and Douglas-fir tussock moth), root diseases, and stem decay caused by the Indian paint fungus (Gast et al. 1991, Hayes et al. 2001, Torgersen 2001, Wickman 1992).

### Understory Removal Cutting

Understory removal cutting is also used in multi-cohort stands but it removes the advance regeneration cohort rather than the overstory cohort (fig. 5). The objective of understory removal cutting is typically to improve the vigor and longevity of overstory trees (such as old ponderosa pines or western larches) by removing their major source of competition – the understory trees.

Understory removals could help restore the abundance of large-diameter trees across the interior Columbia River basin (Quigley et al. 1996) by improving the growth rate of larger intermediate trees such as those in the 15-20" size class. Understory removals, including ladder-fuel reduction treatments to address crown fire susceptibility, are also implemented to improve the physiological vigor of overstory trees, regardless of diameter or age (Graham et al. 1999, 2004).

Note that unlike overstory removal, there is no specific term and associated coding for understory removal.' This means that an understory removal must be coded as an intermediate cutting method – commercial thinning, improvement cutting, or noncommercial thinning are obvious choices depending on silvicultural objectives and stand characteristics (see table 1).

## Uneven-Aged Management

Uneven-aged management uses regeneration and intermediate cutting methods to create and maintain an uneven-aged stand. The uneven-aged regeneration methods are individual-tree and group selection cutting. Uneven-aged management also includes intermediate cutting methods, such as thinnings and improvement cuttings, to adjust stand density and accomplish other cultural objectives for treatment areas containing immature trees.

An important difference between even-aged and uneven-aged management involves the regulation of growing stock. In even-aged management, yields are regulated by controlling the area in each age class and by how the rotation length is established, which is the time period required to grow trees to maturity as indicated by culmination of mean annual increment (Powell 1987). In uneven-aged management, growing stock is used to regulate yields rather than area (even-aged regulation uses the acreage in each age class).

Since uneven-aged management is applied to the entire stand area (although not every acre is treated in every cutting cycle), area objectives (treat 25% of the stand in small groups) are irrelevant. In fact, statements such as “we will treat 25% of the stand with group selection” are a sure tip-off that an even-aged concept is being used because regulation is based on area (i.e., 25% of the stand’s acreage) instead of growing stock (Powell 1987).

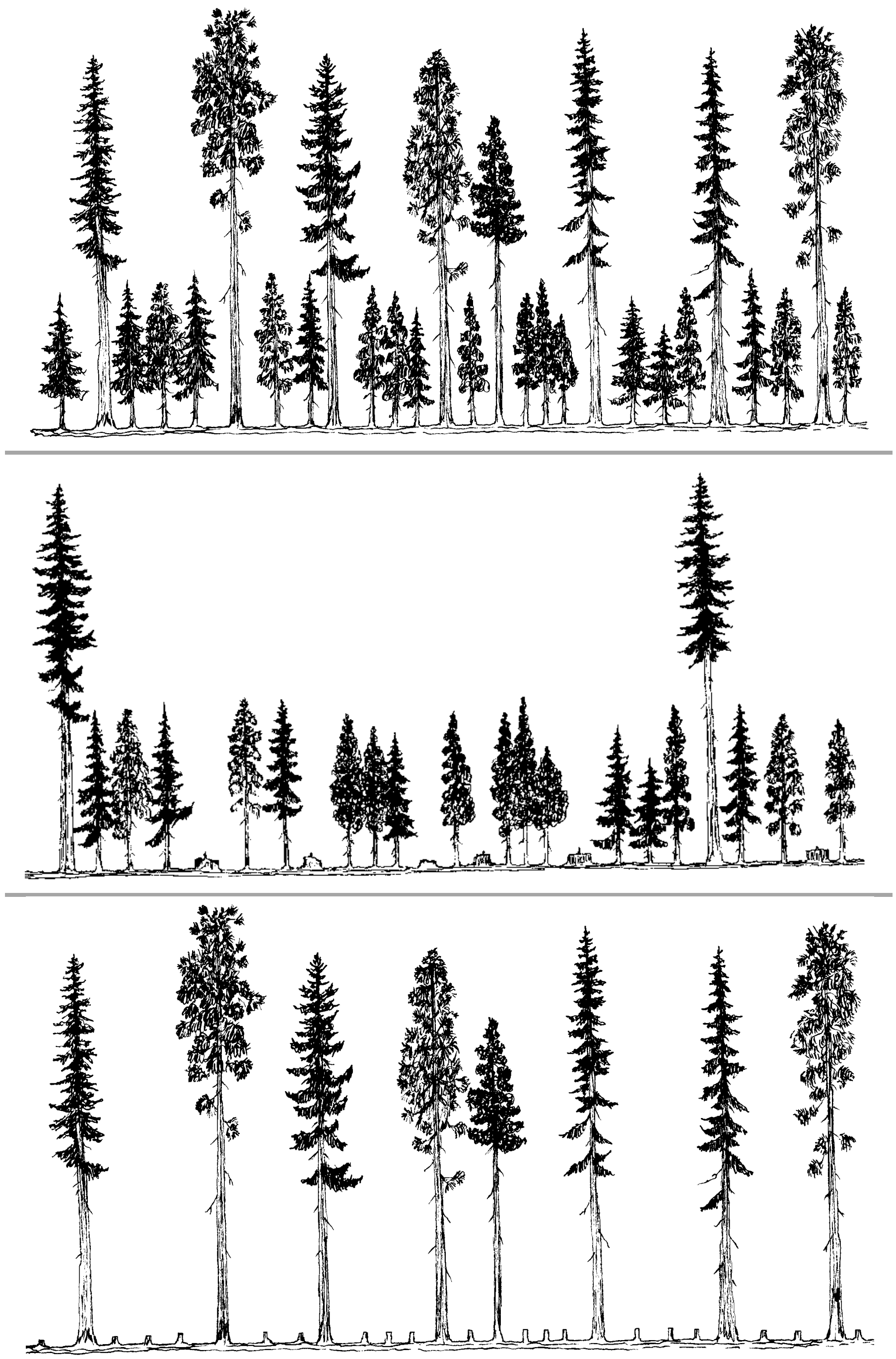

**Figure 5 –** Examples of overstory removal and understory removal cutting in a mixed-conifer forest. Either of these cutting methods is appropriate for two-aged (multi-cohort) stands (top, and see fig. 1). An overstory removal (middle) removes most or all of the overstory trees in order to release a cohort of advanced regeneration. As shown here, a few overstory trees may be reserved depending upon land management objectives (but removing all of the overstory is also appropriate depending on the objectives). An understory removal (lower) removes all or most of the understory cohort; it is typically prescribed in situations where an objective is to improve or maintain the vigor of large-diameter trees such as older ponderosa pine or western larch.

Silvicultural prescriptions for uneven-aged regimes must provide quantified objectives about residual stocking, including specifications for these items (Fiedler 1995):

- Desired diameter distribution (expressed as a Q-factor or based on stand density index);
- Maximum tree size to be retained;
- Residual basal area; and
- Optimum cutting cycle.

### Individual-Tree Selection

This regeneration cutting method involves removing selected trees from certain size or age classes over an entire stand area. Removing single trees creates small openings similar to those resulting from natural mortality, so this method favors the regeneration of species that can tolerate shade (fig. 6).

Individual-tree selection is used to create or maintain an uneven-aged stand. Periodically applying individual-tree selection, along with intermediate cutting methods, eventually results in a stand condition containing trees of many ages and sizes. This cutting method provides maximum flexibility in choosing trees to cut or leave, but it is most applicable to uniformly spaced stands with an irregular or uneven-aged structure. In mixed-species stands, it inevitably leads to an increase in the proportion of shade-tolerant tree species (Powell 1987).

### Group Selection

This regeneration cutting method involves removing small groups of trees. The distance across an opening created by this method is usually no more than one to two times the surrounding tree height, up to a maximum size of two acres. These openings permit more sunlight to reach the forest floor than with individual-tree selection, and some regeneration of shade-intolerant species is possible (fig. 7).

Group selection is used to create or maintain an uneven-aged stand. Periodic application of regeneration and intermediate treatments results in small groups or clumps dispersed through a stand, with each group containing trees of similar ages and sizes. Group selection is an ideal alternative for uneven-aged stands whose existing structure is already groupy or clumpy. When groups approach maximum size (about 2 acres), the openings resemble small-patch clearcuts or the group shelterwood variant (Powell 1987).

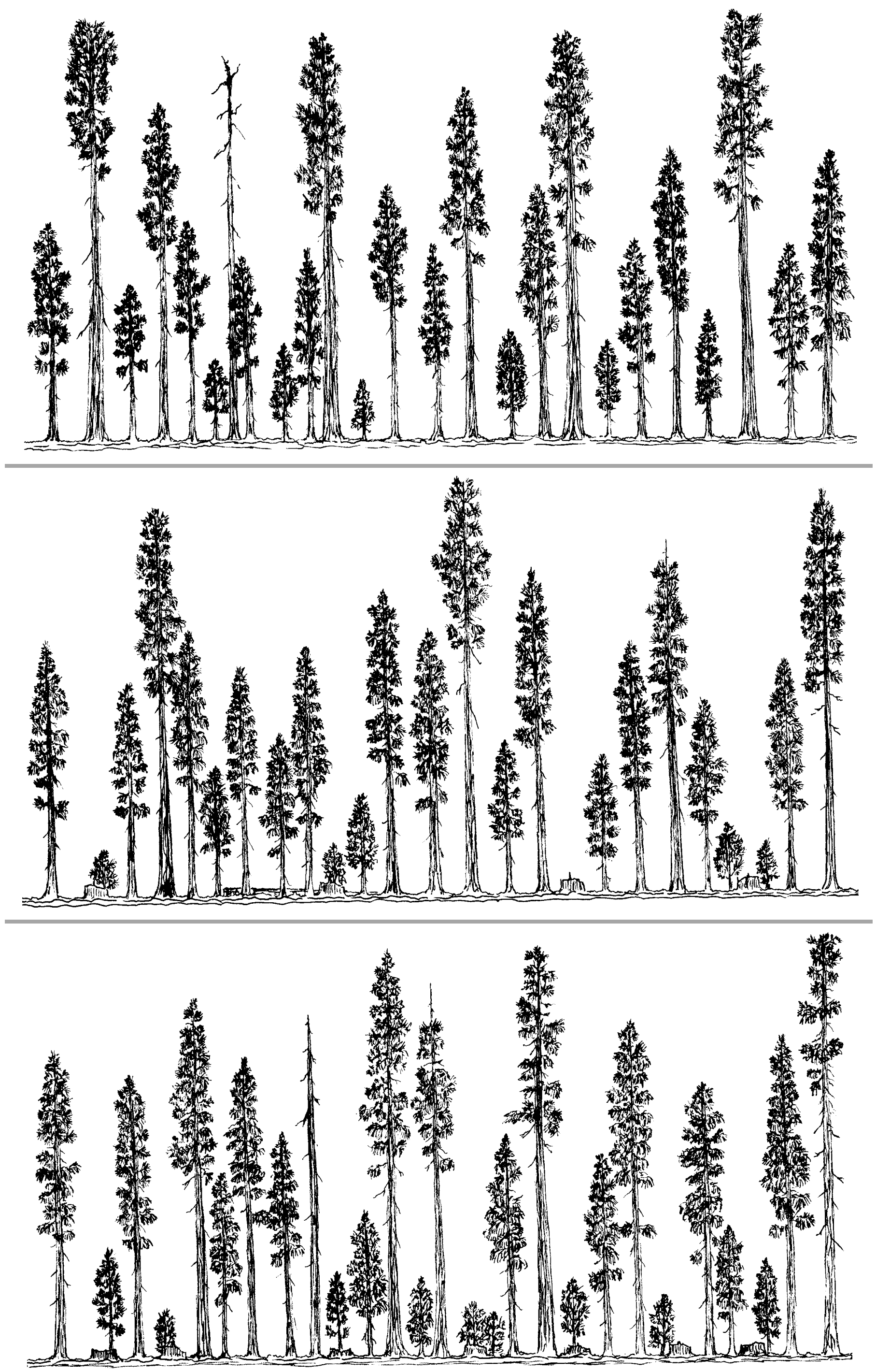

**Figure 6 –** Examples of individual-tree selection cutting in ponderosa pine. Uneven-aged management is best suited for stands with a high proportion of climax species. Because of their shade intolerance, early-seral stands of lodgepole pine or western larch are incompatible with individual-tree selection. In the Blue Mountains, individual-tree selection is most compatible with conditions occurring at either end of the ecological spectrum – climax ponderosa pine forests on hot dry sites, and climax spruce-fir stands on cold dry sites. Uneven-aged management is easier for ponderosa pine when it is climax than when it is successional.

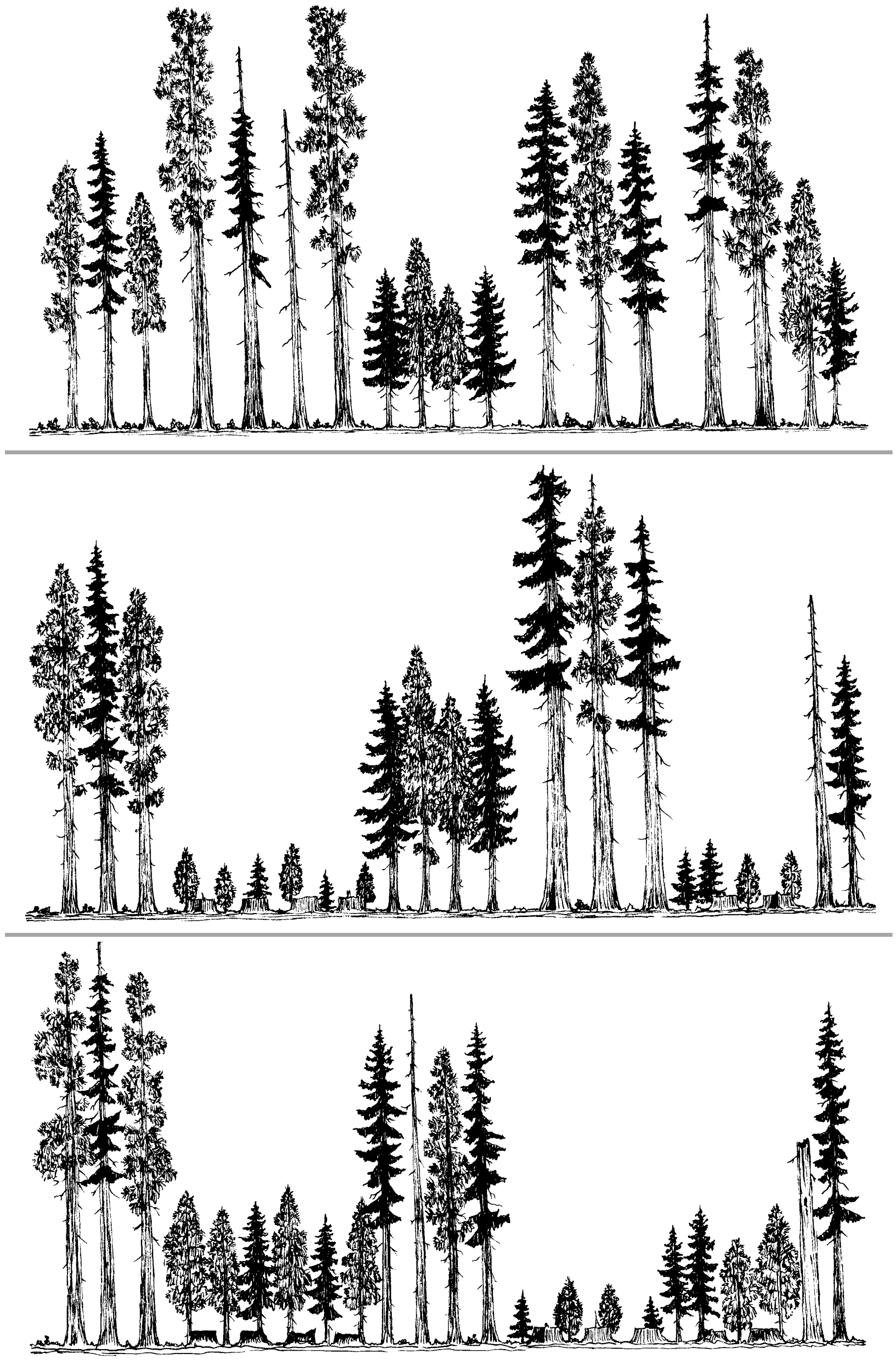

**Figure 7 –** Examples of group selection cutting in a mixed-conifer forest. Group selection cutting is often used in situations where it is desirable to maintain shade-intolerant species in mixed stands. Group selection cutting provides operational advantages because timber harvest damage can be managed by concentrating equipment movement in the openings. If not implemented carefully, group selection can evolve to a situation where entries remove groups of mature trees while ignoring associated cultural treatments (noncommercial thinning, weeding, release, etc.). Also, if group size is too large or not controlled, there may be a tendency to compromise some of the benefits of uneven-aged management, such as site protection and amelioration (Powell 1987).

## Intermediate Cutting Methods

Intermediate cutting methods are used to modify the growth, quality, vigor, composition, or structure of a forest stand after its establishment and prior to its final harvest (USDA Forest Service 2004). This means that there is no objective for obtaining regeneration in association with an intermediate cutting method (but it might occur anyway).

Note, and a little preaching by a terminology wonk: please don't prescribe commercial thinning, improvement cutting, or any other intermediate cutting method, and then state in a prescription or NEPA specialist report that you want regeneration, or expect to obtain it, as a result of the treatment – if you prescribe cutting with a stated objective or expectation of regeneration, then please select a regeneration cutting method for your treatment!
[This caveat does not relate to existing (advanced) regeneration, or to future regeneration occurring as 'background' ingrowth, because either situation generally results from natural processes functioning independently of silvicultural cutting.]

People often think of forests as tranquil and never changing. But change does occur, though it is so slow in old forest as to be referred to as the "invisible present" (Magnuson 1990). Unlike old forests, young forests are dynamic and they change rapidly (Oliver and Larson 1996). Intermediate cutting can influence the speed and direction of young forest dynamics to accelerate development of desired forest structure, reduce fire risk and, at the same time, produce some of the utilitarian goods and services desired by society.

In the U.S. Forest Service, two intermediate cutting methods are traditionally implemented as part of the timber stand improvement program – noncommercial thinning and release (fig. 8).

IMPORTANT NOTE: It is erroneously assumed that intermediate cutting is only associated with even-aged management; this is incorrect – intermediate methods are also used with the two-aged and uneven-aged silvicultural systems (see top of page 2).

# SILVICULTURE TERMINOLOGY AND ECOSYSTEM MANAGEMENT

Silvicultural terms have traditionally focused on the practices, methods, and activities used to manage vegetation, not on the future outcomes or conditions created by applying the treatments. A good example is clearcutting – the objective is not to clear an area and maintain it in a bare condition as long as possible, as if we were managing for parking lots. Clearcutting is just a means to an end (objective). It can be thought of as an activity (practice, method) suitable for reaching our ultimate destination and, in many cases, we could have gotten there just as easily by selecting another activity (such as seed-tree or shelterwood cutting).

In an era of ecosystem management, where we are striving to produce desired future conditions as described in Land and Resource Management Plans, there is a pressing need for a modern, outcome-based terminology. The new terms should focus on results and outcomes (the ends), rather than the methods and practices used to achieve them (the means).

Since we lack a terminology focused on outcomes, I will provide some examples of how current terms can be used (and coded) in an ecosystem management context.

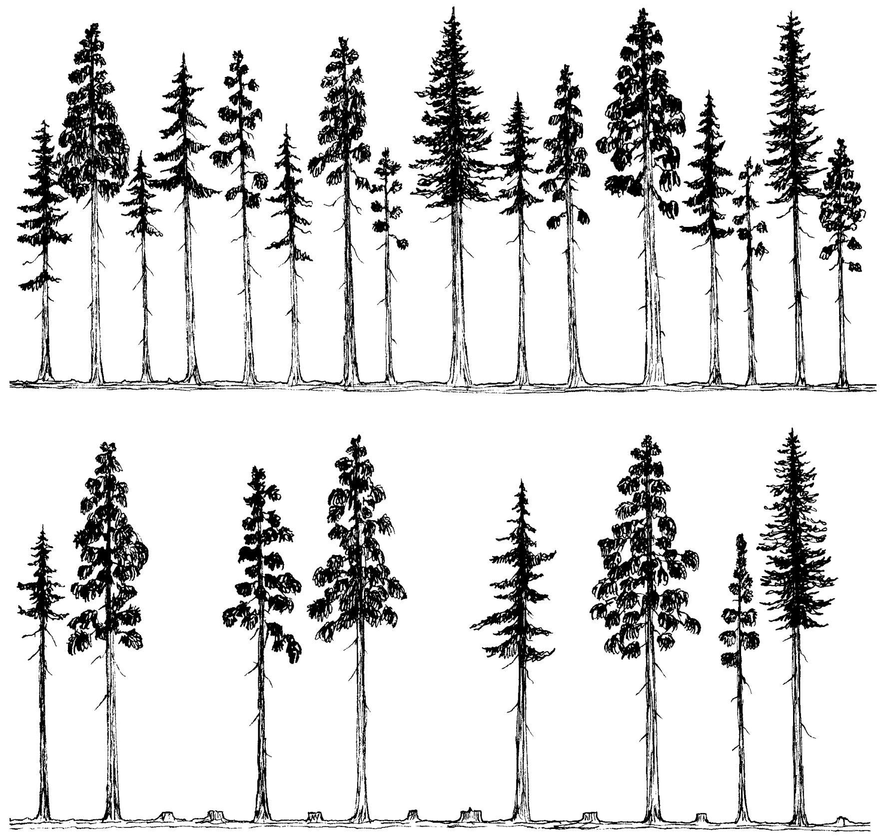

**Figure 8 –** Example of low thinning in a mixed-conifer forest (from Powell 1999). Low thinning is defined as the removal of trees from lower crown classes or canopy layers in order to favor those in upper crown classes or layers. Low thinning is also referred to as 'thinning from below.' Note how smaller trees were removed in every instance but one: the western larch in the center of the top panel was infected with dwarf mistletoe to an extent that threatened its continued survival. Because of its canopy position, the larch would not have been removed in a low thinning except for insect or disease reasons.

1. Smith et al. (1997) state, "the true clear cutting method lays bare the area treated and leads to the establishment of an even-aged high forest." They also admit that there are many circumstances where the term has been loosely applied, but that most of these situations should not be called clearcuts because they represent something other than laying an area bare.

2. Many of the regeneration treatments referred to as sloppy or fuzzy clearcuts result in an on-the-ground appearance far different than application of true clearcutting.

   If enough reserve trees are left in a clearcut to significantly influence its appearance and ecological condition, then the unit should be coded as a seed-tree seed cut, shelterwood seed cut, clearcutting with reserves, or as some other regeneration cutting method that better represents post-harvest environmental conditions. [But, as described on page 4, don't code a seed cut unless the residual trees truly qualify as desirable seed trees.]

3. Although traditional application of both seed-tree and shelterwood cutting involves removing the residual trees after they successfully provide seed and shelter, the definitions do not preclude their long-term retention for other purposes.

   Therefore, retaining green trees for biodiversity purposes, as legacy trees, or for green-tree snag replacements, would best be termed (and coded) as seed-tree or shelterwood cutting with reserves (assuming that the leave trees actually qualify as seed trees).

4. 'Crop-tree management' and other light partial cutting schemes do not qualify as individual-tree selection unless prescribed using uneven-aged management objectives (such as the BDq method; see Fiedler 1995).

   Similarly, regeneration cutting that creates small openings does not automatically qualify as group selection, even when the openings are less than two acres in size, unless the stand structure is regulated using uneven-aged methods (Fiedler 1995, Long 1995).

5. Small openings created in an even-aged stand (openings smaller than 2 acres in size and with no intent to track them as separate stands or polygons in FSVeg or your vegetation database) should be termed small-patch clearcuts and managed as such if the objective is not to create or maintain an uneven-aged stand.

## The Need for Consistency

The terms and definitions we use for silvicultural practices are important, particularly regarding regeneration harvest. One hallmark of a journey-level silviculturist is that he or she has a deep understanding of silvicultural terminology, and is capable of using it carefully and consistently to foster effective communication both within and outside of the silviculture community. Consistency is of primary importance for these reasons:

- Without consistent application of definitions and codes, it will be impossible to use automated database systems such as FACTS to compile meaningful reports. One of the most important functions of systems like FACTS is to provide historical information about which treatments have occurred in the past. This function leaves 'tracks' for the next generation of silviculturists and foresters, but it is only valuable if terminology is applied consistently – what is coded as a clearcut on one unit needs to be the same as a clearcut on another unit.
- Without consistent application of definitions and codes, it will be difficult to monitor the Land and Resource Management Plan (USDA Forest Service 1990) – we might not be sure that what is coded as a particular cutting method on one Ranger District is the same as on another Ranger District.
- Without consistent definitions and codes, we cannot communicate effectively when describing silvicultural treatments in environmental assessments, environmental impact statements, and other NEPA documents. Once again, we need to be sure that what is termed a shelterwood seed cut in Heppner's environmental documentation is reasonably similar to a shelterwood seed cut in Walla Walla's documentation.

Table 1 is designed to provide a consistent set of codes and definitions for many of the silvicultural activities and practices we use when managing forested ecosystems.

**Table 1:** Codes, names, and definitions for regeneration and intermediate cutting methods.

| CODE | NAME AND DEFINITION OF CUTTING METHOD |
|---|---|
| | **REGENERATION CUTTING METHODS** |
| | NOTES: National Forest Management Act regulations require that harvested areas be adequately restocked within 5 years of final harvest (36 CFR 219.27). For a regeneration cutting method involving a series of cuts – seed-tree, shelterwood, selection, and overstory removal cutting – the 5-year requirement begins when the removal cut is made. The tree density immediately after a removal cut must meet or exceed the minimum stocking standards contained in the Forest Plan, or it must be attained within 5 years of the removal cut. |
| 4111 | **Patch (group) clearcutting (EA/RN/FH):** removing all of the live trees from areas that are 2 acres in size or smaller. It is assumed that patches larger than 2 acres are capable of being delineated on a 1:24,000 map and will be managed as new stands following harvest (code patches larger than 2 acres as a stand clearcut). |
| 4115/EA<br>4175/2A | **Patch (group) clearcutting with reserves (EA or 2A/RH/FH):** same as patch clearcutting except that varying numbers of reserve trees are retained to achieve objectives other than regeneration. |
| 4113 | **Stand clearcutting (EA/RH/FH):** removing essentially all live trees from an entire stand, or using clearcut patches or strips that are large enough to manage as new stands after harvest. It is assumed that patch or strip clearcuts smaller than 2 acres will not be managed as new stands following timber harvest. |
| 4117/EA<br>4177/2A | **Stand clearcutting with reserves (EA or 2A/RH/FH):** same as stand clearcutting except that varying numbers of reserve trees are retained to achieve objectives other than regeneration. |
| 4121 | **Shelterwood preparatory cut (EA/NRH/NFH):** removing trees near the end of a rotation to gradually open the canopy and thereby build crown, develop windfirmness and otherwise improve a stand's capability to produce seed. Seed production or regeneration establishment is not an objective of preparatory cutting. |
| 4192 | **Shelterwood preparatory cut with reserves (2A/NRN/NFH):** same as shelterwood preparatory cut except that varying numbers of reserve trees are retained (in addition to the prep trees) to achieve objectives other than regeneration. |
| 4122 | **Seed-tree preparatory cut (EA/NRH/NFH):** same as for shelterwood preparatory cutting except that it is being used with the seed-tree regeneration method. |
| 4131 | **Shelterwood establishment cut (EA/RN/NFH):** removing a significant proportion of the canopy to promote seed production and create conditions conducive to establishment and survival of natural or planted regeneration. When implemented on an area basis, a shelterwood seed cut must leave at least 12 acceptable, well-distributed seed trees per acre (not applicable when using a strip shelterwood because shelter and seed are then provided by the uncut stand). |

| CODE | NAME AND DEFINITION OF CUTTING METHOD |
|---|---|
| 4194 | **Two-aged shelterwood establishment cut with reserves (2A/RN/NFH):** same as shelterwood establishment cut except that varying numbers of reserve trees are retained (in addition to the seed and shelter trees) to achieve objectives other than regeneration. |
| 4132 | **Seed-tree seed cut (EA/RN/NFH):** same as for shelterwood seed cut except that it is being used with the seed-tree regeneration method. When implemented on an area basis, a seed-tree seed cut must leave at least 6 acceptable, well-distributed seed trees per acre (not applicable when using a strip seed cut because shelter and seed are then provided by the uncut stand). |
| 4183 | **Two-aged seed-tree seed cut with reserves (2A/RN/NFH):** same as seed-tree seed cut except that varying numbers of reserve trees are retained (in addition to the seed trees) to achieve objectives other than regeneration. |
| 4141 | **Shelterwood final removal cut (EA/NRN/FH):** removing the trees that were left in a shelterwood seed cut (reserve trees are not used). |
| 4196/2A | **Shelterwood final removal cut with reserves (2A/NRN/FH):** same as shelterwood final removal cut except that varying numbers of reserve trees are retained to achieve objectives other than regeneration (and the reserve trees are retained). |
| 4142 | **Seed-tree final removal cut (EA/NRN/FH):** removing the trees that were left in a seed-tree seed cut (reserve trees are not used). |
| 4146/EA<br>4186/2A | **Seed-tree final removal cut with reserves (EA or 2A/NRN/FH):** same as seed-tree final removal cut except that varying numbers of reserve trees are retained to achieve objectives other than regeneration (and reserve trees are retained). |
| 4144 | **Final overstory removal cut (EA/NRN/FH):** cutting of trees in an upper canopy layer to release advance regeneration. Overstory removal is only applicable to the clear-cutting regeneration method, and only when the primary source of regeneration is advance regeneration. Tree density after harvest must meet or exceed minimum stocking standards contained in the Forest Plan (USDA Forest Service 1990). |
| 4145 | **Final overstory removal cut with reserves (EA/NRN/FH):** same as final overstory removal cut except that varying numbers of reserve trees are retained to achieve objectives other than regeneration (and reserve trees are retained). |
| 4160 | **Partial removal:** removing part of the overstory canopy from a stand. [WARNING: This nebulous code should only be used when no other code is considered appropriate for the treatment – in other words, as a last resort.] |
| 4150 | **Selection cut:** Treatments made to establish and maintain an uneven-aged stand; this general code should only be used in situations where single-tree and group selection cutting are both used in the same stand; otherwise, select a more specific code relating to either single-tree or group selection cutting. |

| CODE | NAME AND DEFINITION OF CUTTING METHOD |
|---|---|
| 4151 | **Single-tree selection cut (UA/RN/NFH):** uneven-aged cutting method where single trees, or small clumps less than ¼ acres in size, are harvested to maintain an uneven-aged stand structure and a regeneration need is created by the cut. |
| 4154 | **Single-tree selection cut (UA/NRN/NFH):** uneven-aged cutting method where single trees, or small clumps less than ¼ acres in size, are removed to maintain an uneven-aged stand structure and a regeneration need is not created by the cut. |
| 4152 | **Group selection cut (UA/RN/FH):** uneven-aged cutting method where groups of trees are removed from areas between ¼ and 2 acres in size to maintain an uneven-aged stand structure. |
| | **INTERMEDIATE CUTTING METHODS** |
| | NOTES: The density of acceptable, undamaged trees after intermediate cutting must meet or exceed the minimum stocking standards contained in the Forest Plan, which are often specified by forest type or working group. "Do not use intermediate cutting to begin the regeneration of even-aged stands. If cutting will be heavy enough to begin the regeneration process, such as in a salvage entry, prescribe a regeneration harvest." (FSM 2471.31 – Cautions.) |
| 4210 | **Improvement cut:** intermediate cutting in stands past the sapling stage to improve their composition and quality. Trees of undesirable species, form or condition are removed from the upper canopy, often in conjunction with an understory thinning. |
| 4211 | **Liberation cut:** intermediate cutting (release treatment) in stands not past the sapling stage to free the favored from competition of older, overtopping trees. |
| 4220 | **Commercial thinning:** intermediate cutting to stimulate growth and development of a residual stand. Commercial thinnings are also made to increase the yield of usable (merchantable) material for a future harvest. |
| 4231 | **Salvage cut:** intermediate cutting to remove trees that are dead or in imminent danger of being killed by insects or other injurious agents. The primary goal is to remove dead trees before they become economically worthless. Note that if salvage harvest will be heavy enough to create a nonstocked opening (see "horizontal diversity" section in Forest-wide standards and guidelines for the Umatilla National Forest Land and Resource Management Plan, page 4-73), then the treatment should be coded as stand clearcutting – salvage mortality (code 4114). |
| 4232 | **Sanitation cut:** intermediate cutting to remove dead, damaged or susceptible trees and help prevent or control the spread of insects and diseases. The sanitation and salvage terms are often used interchangeably but this usage is incorrect. For example, removal of dead trees in a root-disease center would be considered sanitation if the harvest helps slow the spread and intensification of root disease; it would be coded as salvage if the harvest has little or no effect on the root disease. |
| 4240 | **Special cut:** an intermediate entry accomplishing a specific resource objective that cannot be described using another term. [WARNING: This nebulous code should be |

| CODE | NAME AND DEFINITION OF CUTTING METHOD |
|---|---|
| | used as a last resort, and only when no other term is considered appropriate for the treatment.] |

*Sources/Notes:* Definitions were taken from FSM 2400 – Timber Management, chapter 2470 – Silvicultural Practices (USDA Forest Service 2004). Codes were taken from an appendix for the FACTS database application.

**Abbreviations used in conjunction with the regeneration cutting method names are:**

2A = Two ages (two-aged silvicultural system)

EA = Even aged (even-aged silvicultural system)

UA = Uneven aged (uneven-aged silvicultural system)

FH = Final harvest

RH = Regeneration harvest

RN = Regeneration need created

NFH = Not final harvest

NRH = Not regeneration harvest

NRN = No regeneration need created

## ACKNOWLEDGMENTS

Wayne Long, retired fire management officer for the Walla Walla Ranger District of the Umatilla National Forest, prepared the cutting method and stand structure line drawings used throughout this document.

## GLOSSARY

This glossary includes terms that are not defined in the text, or in table 1.

**Active management.** Planned, intentional actions in an area that are specifically designed to obtain a desired objective or result (Boise Cascade Corporation 1996).

**Adaptive management.** A dynamic approach to land management in which the effects of treatments are continually monitored and used, along with research results, to modify management on a continuing basis to ensure that objectives are being met (Helms 1998).

**Advanced regeneration.** Trees that have become established naturally under a mature forest canopy, and are capable of developing normally if the overstory is removed or killed.

**Climax.** The culminating seral stage in plant succession for any given site where, in the absence of catastrophic disturbance, the vegetation has reached a highly stable condition and undergoes change very slowly (Dunster and Dunster 1996). A self-replacing community that is relatively stable over several generations of the dominant plant species, or very persistent in comparison to other seral stages (Kimmins 1997).

**Cohort.** A group of trees developing after a single disturbance, commonly consisting of trees of similar age, although one cohort can include a considerable span of ages ranging from seedlings or sprouts to trees that predated the disturbance (Helms 1998). Stands are often characterized as single-cohort or multicohort depending on whether they contain one or several cohorts (Oliver and Larson 1996).

**Crown class.** A categorization or classification of trees based on their crown position relative to adjacent trees within the same canopy stratum; four primary crown classes are recognized:

> **Dominant** – a tree whose crown extends above the general level of the main canopy, receiving full light from above and partial light from the sides.
>
> **Codominant** – a tree whose crown helps to form the general level of the main canopy, receiving full light from above and limited light from the sides.
>
> **Intermediate** – a tree whose crown extends into the lower portion of the main canopy but is shorter than the codominants, receiving little direct light from above and virtually none from the sides.
>
> **Subcanopy** (overtopped) – a tree whose crown is completely overtopped by the crowns of one or more neighboring trees, occurring in a subordinate or submerged position relative to the main canopy.

**Cutting cycle.** The planned interval between partial harvests in an uneven-aged stand (Helms 1998).

**Cutting method.** Intentional application of silvicultural practices (commercial or noncommercial activities in a tree stand) designed to obtain regeneration or otherwise establish a new stand or tree cohort (regeneration cutting methods), or to tend (culture) an existing stand by modifying its species composition, stand density, or vertical structure (intermediate cutting methods such as release, thinning, weeding, etc.) (Smith et al. 1997). Regeneration and intermediate cutting method definitions are provided in table 1.

**Ecosystem management.** Management driven by explicit goals, executed by policies, protocols and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function (Christensen et al. 1996).

**Forest.** An ecosystem characterized by a more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish, and wildlife (Helms 1998).

**Forest density management.** Cutting or killing trees to increase intertree spacing and to accelerate growth of remaining trees; the manipulation and control of forest (tree) density to achieve one or more resource objectives. Forest density management is often used to improve forest health, to open the canopy for selected trees, to maintain understory vegetation, or to promote late-successional characteristics for biological diversity (Helms 1998).

**Forest health.** The perceived condition of a forest based on concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Note that perception and interpretation of forest health is influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of stands comprising the forest, and the appearance of the forest at a particular point in time (Helms 1998).

**Forest management.** Generally, the branch of forestry concerned with its overall administrative, economic, legal, and social aspects, and with application and coordination of its essentially scientific and technical aspects such as silviculture, protection, and regulation (Doliner and Borden 1984).

**Forest stand.** A contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit (Helms 1998).

**Growing space.** An intangible measure of the total resources of a site (sunlight, moisture, nutrients, etc.) that is available to a plant (Helms 1998). Growing space refers to the availability of all resources needed by a plant to exist on a given site (O'Hara 1996).

**Low thinning.** The removal of trees from lower crown classes, layers, or strata to favor those in upper crown classes, layers or strata; also referred to as "thinning from below."

**Natural regeneration.** The renewal of a forest community by natural (as compared to human) means, such as tree seedling establishment from seed produced on-site or from adjacent areas, or from seed brought in by wind currents, birds, or animals.

**Overstocked.** Forestland stocked with more trees than normal, or that full stocking would require (Dunster and Dunster 1996). In an overstocked stand, tree density is so high that intense intertree competition is occurring, and large trees are taking growing space away from small trees in a density-dependent process called self-thinning.

**Overstory.** In a forest with more than one story (layer), that portion of the trees forming the uppermost canopy layer; in a two-storied forest (stands with two clearly defined canopy layers), the tallest trees form the overstory and the shortest trees the understory (Helms 1998).

**Partial cutting.** Harvest operation in which only certain trees are removed from a stand of merchantable trees.

**Reforestation.** The natural or artificial renewal of a forest ecosystem by establishing trees. Also called regeneration.

**Reserve trees.** Live trees, pole-sized or larger, retained in either a dispersed or aggregated manner after the regeneration period under the clearcutting with reserves, seed-tree with reserves, shelterwood with reserves, group selection with reserves, or coppice with reserves regeneration methods. Reserve trees are retained for objectives other than regeneration, such as provision of future snags (e.g., green-tree replacement trees).

**Residual trees.** Trees remaining in an area following tree harvest, thinning, or other disturbance events such as insect or disease outbreaks and wildfire.

**Rotation.** In even-aged systems, the period (in years) between regeneration establishment and final cutting (Helms 1998). Note that the National Forest Management Act requires that the rotation age be established in such a way that it coincides with the age at which culmination of mean annual increment (CMAI) has occurred – the rotation age must be the same as, or greater than, the CMAI age.

**Selective cutting.** A system in which groups of trees or individual trees are periodically removed from the forest, as based on economic criteria aimed at maximizing commodity revenues rather than trying to meet silvicultural objectives such as regeneration (Dunster and Dunster 1996). Compare with: selection cutting definitions provided in table 1 (page 18).

**Seral stage.** The identifiable stages in the development of a sere, from an initial pioneer stage, through various early and mid-seral stages, to late seral, subclimax, and climax stages. The stages are identified by different plant communities, different ages of the dominant vegetation, and by different microclimatic, soil, and forest conditions (Kimmins 1997). Four seral stages are recognized (Hall et al. 1995):

> **Early Seral**: clear dominance of seral species (western larch, ponderosa pine, lodgepole pine, etc.); PNC species are absent or present in very low numbers.
>
> **Mid Seral**: PNC species are increasing in the forest composition as they actively colonize the site; PNC species are approaching equal proportions with seral species.
>
> **Late Seral**: PNC species are now dominant, although long-lived seral species (ponderosa pine, western larch, etc.) may still persist in the plant community.
>
> **Potential Natural Community (PNC)**: the biotic community that one presumes would be established and maintained over time under present environmental conditions; seral species are scarce or absent in the plant composition.

**Shade tolerance.** The capacity of trees to grow satisfactorily in the shade of, and in competition with, other trees (Helms 1998). Also see: tolerance.

**Silvicultural prescription.** A planned series of treatments designed to change current forest structure to one meeting the goals and objectives established for an area (Helms 1998). A prescription is a written statement or document defining the outcomes to be attained from silvicultural treatments. The outcomes are generally expressed as acceptable ranges of the various indices being used to characterize forest development (Dunster and Dunster 1996).

**Silvicultural system.** A planned series of treatments for tending, harvesting, and reestablishing a stand of trees. Note that the series of treatments typically involves both regeneration cutting methods and intermediate cutting methods (see the cutting method definitions provided in table 1). Three silvicultural systems are recognized: even-aged, two-aged, and uneven-aged.

**Silvicultural treatment.** A process or action that can be applied in a controlled manner, according to the specifications of a silvicultural prescription or forest plan, to improve actual or potential benefits (Hoffman et al. 1999).

**Silviculture.** Applying techniques or practices to manipulate forest vegetation by directing stand and tree development and creating or maintaining desired conditions. Silviculture is based on an ecosystem concept emphasizing the need to evaluate the many abiotic and biotic factors influencing the choice and outcome of silvicultural treatments and their sequence over time, and the long-term consequences and sustainability of management regimes. [Definition derived from multiple sources.]

**Stocking.** The amount of anything on a given area, particularly in relation to what is considered optimum; in silviculture, an indication of growing-space occupancy relative to a pre-established standard.

**Thinning.** A silvicultural treatment in immature forests designed to reduce tree density and improve growth of the residual trees, enhance forest health, or recover potential mortality resulting from intertree competition (Helms 1998). Two types of thinning are recognized (Powell et al. 2001):

> **Commercial thinning:** a thinning where trees being removed have characteristics imparting economic value (sufficiently large size, etc.), which then allows them to be sold to a business enterprise.
>
> **Noncommercial (precommercial) thinning:** a thinning where trees being removed are too small to be sold for conventional wood products such as lumber; the excess trees are typically left on site after being cut, or are concentrated into piles and then burned.

**Timber stand improvement.** Treatments in immature forests to improve the composition, structure, condition, health, and growth of tree stands. The goal of timber stand improvement activities is to improve forest health, or to accomplish other objectives by regulating stand density, removing competing vegetation and fuel ladders, and maintaining soil productivity.

**Tolerance.** A forestry term expressing the relative ability of a plant (tree) to complete its life history, from seedling to adult, under the cover of a forest canopy and while experiencing competition with other plants (Harlow et al. 1996). In general ecology usage, tolerance refers to the capacity of an organism or biological process to subsist under a given set of environmental conditions. Note that the range of conditions under which an organism can subsist, representing its limits of tolerance, is termed its ecological amplitude (Helms 1998).

**Tree harvest.** The felling, skidding, on-site processing, and loading of trees onto trucks for transport to a market or to an off-site facility for further processing (Helms 1998).

**Understory.** All of the vegetation growing under a forest overstory. In some instances, understory is only considered to be small trees (e.g., in a forest comprised of multiple canopy layers, the taller trees form the overstory, the shorter trees the understory); in other instances, understory is assumed to include herbaceous and shrubby plants in addition to trees. When understory refers to trees only, other plants (herbs and shrubs) are often called an undergrowth to differentiate between the two components (Helms 1998).

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## APPENDIX: SILVICULTURE WHITE PAPERS

White papers are internal reports, and they are produced with a consistent formatting and numbering scheme – all papers dealing with Silviculture, for example, are placed in a silviculture series (Silv) and numbered sequentially. Generally, white papers receive only limited review and, in some instances pertaining to highly technical or narrowly focused topics, the papers may receive no technical peer review at all. For papers that receive no review, the viewpoints and perspectives expressed in the paper are those of the author only, and do not necessarily represent agency positions of the Umatilla National Forest or the USDA Forest Service.

Large or important papers, such as two papers discussing active management considerations for dry and moist forests (white papers Silv-4 and Silv-7, respectively), receive extensive review comparable to what would occur for a research station general technical report (but they don't receive blind peer review, a process often used for journal articles).

White papers are designed to address a variety of objectives:

(1) They guide how a methodology, model, or procedure is used by practitioners on the Umatilla National Forest (to ensure consistency from one unit, or project, to another).

(2) Papers are often prepared to address ongoing and recurring needs; some papers have existed for more than 20 years and still receive high use, indicating that the need (or issue) has long standing – an example is white paper #1 describing the Forest's big-tree program, which has operated continuously for more than 25 years.

(3) Papers are sometimes prepared to address emerging or controversial issues, such as management of moist forests, elk thermal cover, or aspen forest in the Blue Mountains. These papers help establish a foundation of relevant literature, concepts, and principles, and they continuously evolve as an issue matures, experiencing many iterations (versions) through time. [But also note that some papers have not changed since their initial development, in which case they reflect historical concepts or procedures.]

(4) Papers synthesize science viewed as particularly relevant to geographical and management contexts for the Umatilla National Forest. This is considered to be the Forest's self-selected 'best available science' (BAS), realizing that non-agency commenters would generally have a different perception of what constitutes BAS – like beauty, BAS is in the eye of the beholder.

(5) The objective of some papers is to locate and summarize the science germane to a particular topic or issue, including obscure sources such as master's theses or Ph.D. dissertations. In other instances, a paper may be designed to wade through an overwhelming amount of published science (dry-forest management), and then synthesize sources viewed as being most relevant to a local context.

(6) White papers function as a citable literature source for methodologies, models, and procedures used during environmental analysis – by citing a white paper, specialist reports can include less verbiage describing analytical databases, techniques, and so forth, some of which change little (if at all) from one planning effort to another.

(7) White papers are often used to describe how a map, database, or other product was developed. In this situation, the white paper functions as a 'user's guide' for the new product. Examples include papers dealing with historical products: (a) historical fire extents for the Tu-

cannon watershed (WP Silv-21); (b) an 1880s map developed from General Land Office survey notes (WP Silv-41); and (c) a description of historical mapping sources (24 separate items) available from the Forest's history website (WP Silv-23).

These papers are available from the Forest's website: Silviculture White Papers

| Paper # | Title |
|---|---|
| 1 | Big tree program |
| 2 | Description of composite vegetation database |
| 3 | Range of variation recommendations for dry, moist, and cold forests |
| 4 | Active management of dry forests in the Blue Mountains: silvicultural considerations |
| 5 | Site productivity estimates for upland forest plant associations of the Blue and Ochoco Mountains |
| 6 | Fire regimes of the Blue Mountains |
| 7 | Active management of moist forests in the Blue Mountains: silvicultural considerations |
| 8 | Keys for identifying forest series and plant associations of the Blue and Ochoco Mountains |
| 9 | Is elk thermal cover ecologically sustainable? |
| 10 | A stage is a stage is a stage…or is it? Successional stages, structural stages, seral stages |
| 11 | Blue Mountains vegetation chronology |
| 12 | Calculated values of basal area and board-foot timber volume for existing (known) values of canopy cover |
| 13 | Created openings: direction from the Umatilla National Forest land and resource management plan |
| 14 | Description of EVG-PI database |
| 15 | Determining green-tree replacements for snags: a process paper |
| 16 | Douglas-fir tussock moth: a briefing paper |
| 17 | Fact sheet: Forest Service trust funds |
| 18 | Fire regime condition class queries |
| 19 | Forest health notes for an Interior Columbia Basin Ecosystem Management Project field trip on July 30, 1998 (handout) |
| 20 | Height-diameter equations for tree species of the Blue and Wallowa Mountains |
| 21 | Historical fires in the headwaters portion of the Tucannon River watershed |
| 22 | Range of variation recommendations for insect and disease susceptibility |
| 23 | Historical vegetation mapping |
| 24 | How to measure a big tree |
| 25 | Important insects and diseases of the Blue Mountains |
| 26 | Is this stand overstocked? An environmental education activity |
| 27 | Mechanized timber harvest: some ecosystem management considerations |
| 28 | Common plants of the south-central Blue Mountains (Malheur National Forest) |
| 29 | Potential natural vegetation of the Umatilla National Forest |

| Paper # | Title |
|---|---|
| 30 | Potential vegetation mapping chronology |
| 31 | Probability of tree mortality as related to fire-caused crown scorch |
| 32 | Review of the “Integrated scientific assessment for ecosystem management in the interior Columbia basin, and portions of the Klamath and Great basins” – forest vegetation |
| 33 | Silviculture facts |
| 34 | Silvicultural activities: description and terminology |
| 35 | Site potential tree height estimates for the Pomeroy and Walla Walla ranger districts |
| 36 | Tree density protocol for mid-scale assessments |
| 37 | Tree density thresholds as related to crown-fire susceptibility |
| 38 | Umatilla National Forest Land and Resource Management Plan: forestry direction |
| 39 | Updates of maximum stand density index and site index for the Blue Mountains variant of the Forest Vegetation Simulator |
| 40 | Competing vegetation analysis for the southern portion of the Tower Fire area |
| 41 | Using General Land Office survey notes to characterize historical vegetation conditions for the Umatilla National Forest |
| 42 | Life history traits for common conifer trees of the Blue Mountains |
| 43 | Timber volume reductions associated with green-tree snag replacements |
| 44 | Density management field exercise |
| 45 | Climate change and carbon sequestration: vegetation management considerations |
| 46 | The Knutson-Vandenberg (K-V) program |
| 47 | Active management of quaking aspen plant communities in the northern Blue Mountains: regeneration ecology and silvicultural considerations |
| 48 | The Tower Fire…then and now. Using camera points to monitor postfire recovery |
| 49 | How to prepare a silvicultural prescription for uneven-aged management |
| 50 | Stand density conditions for the Umatilla National Forest: a range of variation analysis |
| 51 | Restoration opportunities for upland forest environments of the Umatilla National Forest |
| 52 | New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas? |
| 53 | Eastside Screens chronology |
| 54 | Using mathematics in forestry: an environmental education activity |
| 55 | Silviculture certification: tips, tools, and trip-ups |
| 56 | Vegetation polygon mapping and classification standards: Malheur, Umatilla, and Wallowa-Whitman national forests |
| 57 | The state of vegetation databases on the Malheur, Umatilla, and Wallowa-Whitman national forests |

## REVISION HISTORY

**April 2012**: Since its inception in June of 1992, this white paper has been revised at least a dozen times, but no specific revision history was maintained because a ‘revision history’ convention was not instituted until the Umatilla National Forest developed a new white-paper format in late 2011. For the April 2012 version, formatting and editing changes were made, and activity coding was adjusted to agree with Appendix B of the FACTS User Guide.

**February 2013**: Formatting and editing changes were made, and appendix 1 was added describing the silviculture white paper system, including a list of available white papers.